

Compressible Particle Model for Turbulent Mix Calculations

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A compressible particle model supported by the Advanced Simulation and Computing (ASC) Turbulence/Mix Project is currently under development using the T-3 CHAD code as a test bed.

In order to test the particle model compressible terms, a test case driven by pressure gradient and including high-speed flow was needed. Such a case is the axisymmetric, supersonic nozzle discussed in Ref. [1]. The nozzle geometry and computational mesh is shown in Fig. 1. The top is the nozzle wall and the bottom is

the centerline. Subsonic flow enters from the left and supersonic flow exits from the right. The CHAD code is first used to calculate the steady flow without particles. Figure 2 shows the steady-state Mach number contours. Then the particles are introduced at the left. Figure 3 shows the particles approaching the throat region (top) and passing through the throat region (bottom). From this figure, the large amount of shear in the throat region is evident.

Figure 4 shows the effect on particle velocity of varying the particle drag coefficient (CD). The oscillations are due to the fact that the particles communicate with the gas flow through the nearest element vertex. An improved procedure that interpolates inside an element is being developed. Other studies varying the particle density, initial velocity, and injection location are in progress.

[1] L.E. Thode, et al., "Comparison among Five Hydrodynamic Codes with a Diverging-Converging Nozzle Experiment," Los Alamos National Laboratory report LA-13653 (Sept. 1999).

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Figure 1—
Nozzle geometry and computational mesh.

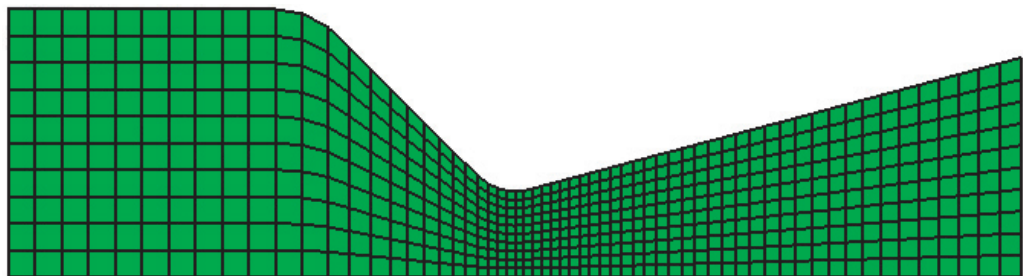
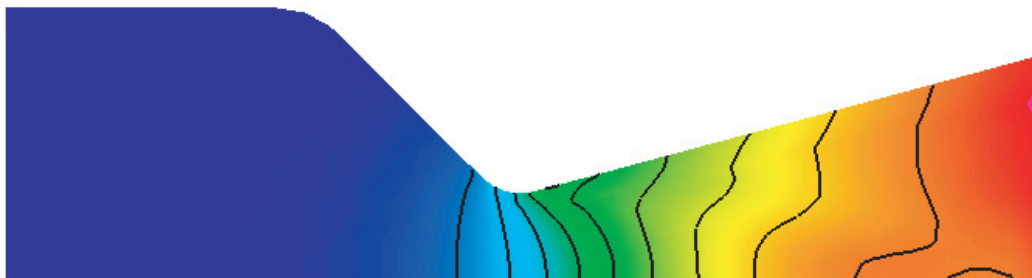


Figure 2—
Steady-state Mach number contours (blue = 0.034, red = 3.4).



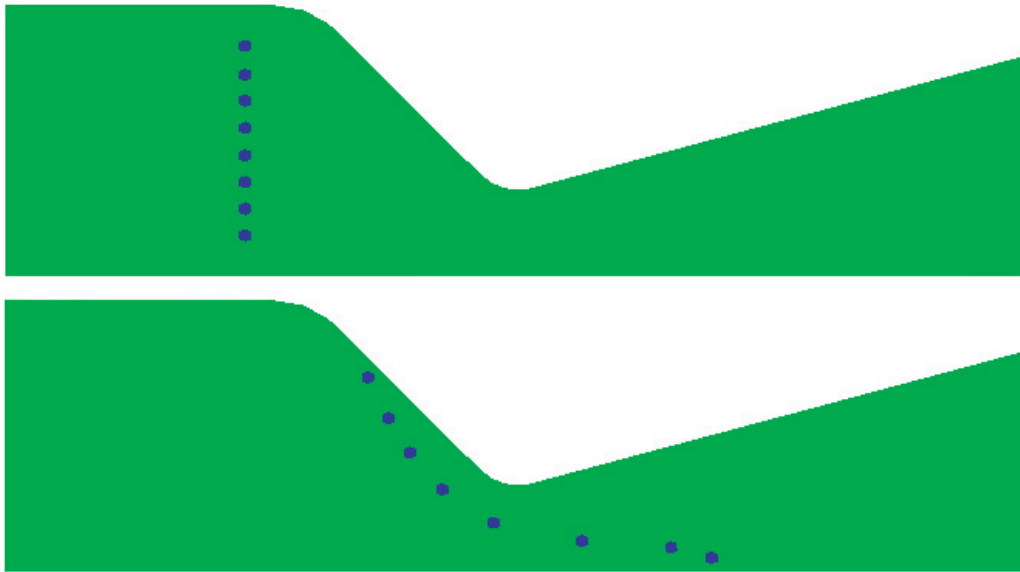


Figure 3—
Particles approaching the throat region (top) and passing through the throat region (bottom).

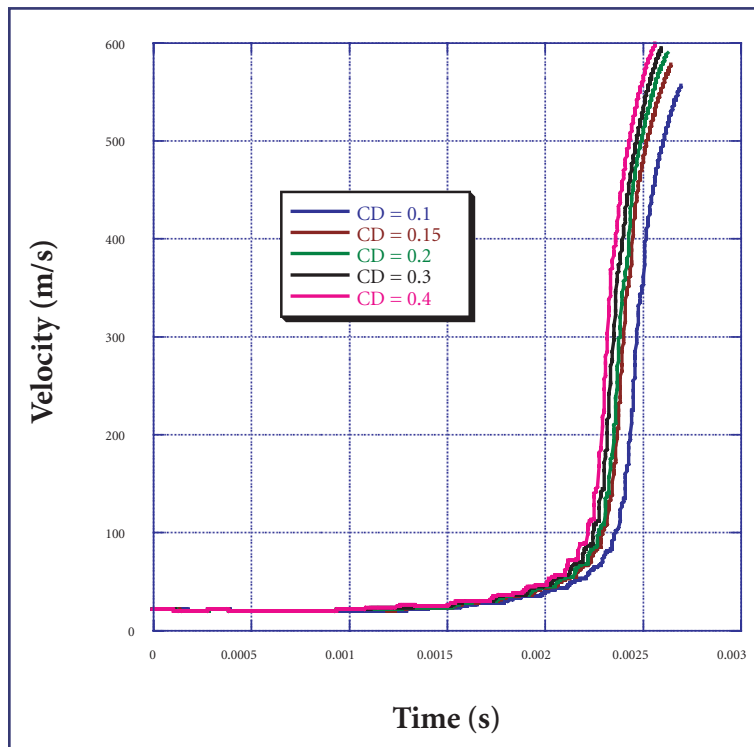


Figure 4—
Effect on particle velocity of varying the particle drag coefficient (CD).

Acknowledgements

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